

THE EVOLUTIONARY STATUS OF SHORT-PERIOD RS CVn AND RELATED W UMA
ECLIPSING BINARIES

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Among the RS CVn stars showing solar-type activity, with spectral types ranging from F to K and total masses up to $4 M_{\odot}$, there are two peculiar groups with period less than one day: a) a group with components well inside their Roche lobes (Short-Period-Group, hereinafter SPG) and b) a group with their components in a thin or marginal degree of contact, with lightcurves of W UMA-W type (hereinafter WWG).

We hypothesized (Milano, 1981, Milano, Russo, Mancuso, 1981) a possible linkage between SPG and WWG in the sense of an evolution SPG WWG taking into account the following observed properties:

- a) in the period-colour diagram the representative points of the two groups lie on two parallel bands, showing a reddening of SPG with increasing period;
- b) high variability of the observed lightcurves with pseudo-regular migrating waves for SPG, and less regular variations for WWG;
- c) a possible correlation between orbital periods and mass ratios;
- d) the angular orbital momentum as a function of the total mass of the systems considering empirical relations for detached, semidetached and contact systems (Chaubey, 1979) for SPG group (d systems) is typically of sd systems, whilst for WWG group is typical of contact systems;
- e) Ca II and Mg II emission lines are present in both groups.

Among the observed properties there is the $\log H_{\text{orb}}$ vs $\log M_{\text{tot}}$ diagram that could be a strong indication of evolution with angular orbital momentum loss (AML) and this fact can support the current theory by Vilhu (1982), Rahunen (1981), van't Veer (1979). We computed the orbital angular momentum of a set of about 450 close binary systems with spectral types ranging from A8 to M, and total masses up to $6M_{\odot}$ using the data by Brancewicz and Dworak (1980), and there is a spread of points between the d, sd and c lines already mentioned above. This could imply that the AML process is slow. We think, notwithstanding these evidences, that it is necessary to try to establish an age scale, using the anti-correlation between Ca II emission strength and stellar age (Wilson and Skumanic, 1964, Skumanic, 1972). Moreover, the primary density vs primary colour diagram (Mochnacki, 1981) which should contain the same

informations of the period-colour diagram, but with the effects of different mass-ratios and fill-out removed does not seem a good indicator of the evolutionary status, owing to the lack of knowledge of the behaviour of the radius in the case of AML evolution.

To throw light on the problems outlined above, we have begun a systematic analysis both of photoelectric lightcurves and of optical and ultraviolet spectra.

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DISCUSSION

Dupree: Could you comment on what you see as the evolutionary status of the contact systems?

Russo: We know that the W UMa binaries are divided into A-type and W-type and that the A-type are evolved systems. In this view the W-type should be less evolved than the A-type. I do not think however that the next stage of evolution of the W-type will be the A-type. I believe that the process of formation of contact systems is not unique and we can have a different kind of life for the different systems.

Dupree: You do not then see a continuity in evolution from the short- to the long-period systems i.e. from the W's to the A's.

Russo: I think that there is no continuity. I believe that the A-type are evolved systems which originate as contact systems, while the W-type are contact systems which do not originate as contacts but detached systems. These latter are young because the process of going from detached to contact should last about 10^8 years according to some calculations of magnetic braking, if there is enough magnetic field i.e. about 1000 G.